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RESEARCH PROJECT TITLE

Identification of Practices, Design, Construction, and Repair Using Trenchless Technology

SPONSORS

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The mission of the Iowa SUDAS Corporation is to develop and maintain urban design standards and standard specifications for the State of Iowa that will be recognized, adopted, and used by state and local government, contractors, and consulting engineers as the acceptable standards for construction of urban public environments.

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Practices, Design, Construction, and Repair Using Trenchless Technology

tech transfer summary

Understanding current trenchless technology and practices can help improve trenchless design and use in the future.

Objectives

- Document the current practices and applications of trenchless technology in the United States, particularly in Iowa.
- Evaluate the effects of trenchless construction on surrounding soil and adjacent structures.
- Provide information about different trenchless technology methods and document current construction and quality control/quality assurance (QC/QA) practices.



Horizontal directional drilling machine used for a trenchless construction project in Ames, Iowa

Problem Statement

Trenchless technologies are used to install and rehabilitate underground utilities when open-cut excavations are impossible or undesired. The primary advantage of these technologies is that they are designed to minimize disruptions to nearby facilities.

Trenchless technologies are being used with greater frequency because of the growing need to replace aging utility infrastructure and to develop more flexible solutions for installing new infrastructure. However, technical data regarding the use of trenchless technologies and their effects on soils and nearby structures, especially pavements, is limited.

Research Description

To determine attitudes toward and uses of trenchless technologies, surveys were sent to professionals in Iowa, Midwestern states, and other U.S. regions. Respondents identified trenchless technologies they used or were familiar with, described pavement distresses they had witnessed, and provided suggestions for future improvements. Some professionals were also interviewed for more in-depth analysis.

To study the effects of trenchless construction on surrounding soils and adjacent structures, a field investigation was conducted that included observations of 19 trenchless construction projects. The research team documented construction procedures, interviewed personnel, tested soil samples in the laboratory, and measured stress changes in the soil during construction.

Key Findings

- Surveys and interviews indicated that the frequency of pavement distress and other trenchless-related issues are an ongoing problem in the industry.
- None of the projects that researchers visited had systematic QC/QA processes.
- Few contractors conduct soil testing because they have prior knowledge of the soil types in the areas in which they commonly work.
- During horizontal directional drilling, using the correct drilling fluid mixture for the soil conditions can help prevent hydraulic fracture of the borehole walls due to drilling fluid pressure (i.e., frac-out).
- Frac-out can be caused by high drilling fluid pressure, excessive reamer speed, lack of soil cohesion, lack of borehole stability, or a combination of these.
- For auger boring and tunneling, care must be taken to avoid undermining pavements in granular (sandy) soils.



Five-inch-diameter drill bit emerging from the ground

- Trenchless technologies were effective methods for utility installation at all 19 field visit sites.
- Boring does affect the surrounding soil by increasing the pressure.

Implementation Benefits

- Trenchless construction methods allow utility pipe to be installed deeper, save both time and money, and offer lower social costs than open-cut methods.
- By understanding the effects of trenchless technologies on soil properties and on the performance of subgrade soils and pavements, the design and practice of trenchless construction can be improved. These improvements can reduce the risk of damage to overlying pavement and nearby underground structures.

Recommendations

- Soil testing should be conducted in areas where soil conditions are unknown or uncertain. Owners and designers should be aware of soil conditions and design limitations that may increase the risk of damage to pavements and nearby structures.
- Trenchless construction methods should continue to be studied so that damage to pavements and other structures can be avoided. Specifications and quality control and quality assurance procedures should be implemented to reduce risks.
- In future trenchless construction research, soil pressure could be monitored during horizontal directional drilling to better understand how trenchless technologies may interact with soils to cause pavement damage and other problems.
- Further understanding the causes of the fluid pressure buildups that lead to soil heave and frac-out can help decrease the risk of these problems.



Drilling fluid at ground surface resulting from frac-out